Real-Time Weather Monitoring and Analysis

Problem Statement:

You are tasked with designing a real-time weather monitoring and analysis system. The system should gather weather data from various locations, store it efficiently, and provide analytical insights to users.

Functional Requirements:

Data Collection:

- Utilize a weather data API (e.g., OpenWeatherMap) to obtain real-time weather information for various locations.
- Store weather data efficiently in the Weather_Data table, ensuring data integrity and consistency.

Data Analysis:

- Develop SQL queries to display real-time weather conditions for different locations.
- Calculate trends and patterns in weather data over time (e.g., hourly temperature changes, monthly precipitation trends).
- Integrate weather data with forecasting models to visualize potential future weather conditions.
- Utilizes advanced SQL features such as joins, window functions, subqueries, and common table expressions (CTEs) for complex analysis tasks.
- Implement features to calculate and display weather metrics such as average temperature, total precipitation, and highest wind speed for each location.

Data Maintenance:

- Implement mechanisms to periodically fetch new data from the weather data API and update the database accordingly.
- Ensure data consistency and accuracy by handling errors and exceptions during data retrieval and storage processes.

Databases Schema

Locations Table:

- **location_id (Primary Key)**: Unique identifier for each location.
- **location_name:** Name of the location.
- **latitude:** Latitude coordinate of the location.
- **longitude:** Longitude coordinate of the location.

Weather_Data Table:

- **data_id (Primary Key):** Unique identifier for each weather data entry.
- **location_id (Foreign Key):** Reference to the location the data belongs to.
- **timestamp:** Timestamp of the weather data entry.
- **temperature:** Temperature recorded at the location.
- **humidity:** Humidity level recorded at the location.
- **precipitation:** Precipitation amount recorded at the location.
- **wind_speed:** Wind speed recorded at the location.
- **weather_condition:** Description of the weather condition (e.g., sunny, rainy, cloudy).

Complete SQL Analysis

1. List all locations stored in the Locations table.
2. Retrieve the temperature and humidity for a specific location at a particular timestamp.
3. Display the total count of weather data entries for each location.
4. Find the average temperature for all locations.
5. List all locations with their respective latitude and longitude.
6. Calculate the highest recorded temperature for each location.
7. Display the weather conditions for a specific location and timestamp.
8. Find the locations with the lowest humidity levels.
9. List the timestamps for which weather data is available.
10. Identify locations with temperatures above 25 degrees Celsius.
11. Rank locations based on the highest wind speed recorded.
12. Determine the average humidity for each month across all locations.
13. List locations with precipitation greater than 5mm.
14. Find the timestamp with the highest recorded temperature across all locations.
15. Calculate the total precipitation for each location in the last 7 days.

16. Identify locations where the temperature is higher than the average temperature across all locations.
17. Display the top 5 locations with the highest humidity levels.
18. Rank locations based on the number of weather data entries.
19. Find the locations with the most frequent occurrences of rainy weather conditions.
20. List all locations and their respective weather conditions at the latest timestamp.
21. Calculate the difference between the maximum and minimum temperatures for each location.
22. Identify locations where the temperature has been steadily increasing over the past week.
23. Display the weather conditions for the most recent entry of each location.
24. Determine the month with the highest average temperature across all locations.
25. Rank locations based on the total precipitation they received in the last month.
26. Find locations where the wind speed is higher than the average wind speed.
27. Calculate the moving average of temperature for each location over the last 7 days.
28. Identify locations that experienced a temperature drop of more than 5 degrees Celsius within an hour.
29. Display the top 3 locations with the highest average temperature in the last month.
30. Find the location with the maximum temperature variation within a day.
31. Display Real-Time Weather Conditions for Different Locations
32. Calculate Trends and Patterns in Weather Data Over Time